

CLAIMS

1. A nanoparticle-nanostructured material composite comprising:
a nanostructured material; and
substantially uniform metal nanoparticles disposed on a surface of the nanostructured material.
2. The nanoparticle-nanostructured material composite of claim 1 wherein said nanoparticles have a size range capable of producing enhanced local fields when excited externally.
3. The nanoparticle-nanostructured material composite of claim 1 wherein said nanostructured material comprises a high surface to volume ratio material.
4. The nanoparticle-nanostructured material composite of claim 3 wherein said high surface to volume ratio material comprises a continuous void network material.
5. The nanoparticle-nanostructured material composite of claim 4 wherein said high surface to volume ratio material comprises a void-column material.
6. The nanoparticle-nanostructured material composite of claim 2 wherein said external excitation is electro-magnetic.
7. The nanoparticle-nanostructured material composite of claim 2 wherein said enhanced local fields in a local region in the vicinity of said nanoparticles are capable of increasing Raman scattering in said local region.
8. The nanoparticle-nanostructured material composite of claim 2 wherein said enhanced local fields are capable of enhancing transitional phenomena.

9. The nanoparticle-nanostructured material composite of claim 8 wherein said transitional phenomenon comprises optical absorption.
10. The nanoparticle-nanostructured material composite of claim 8 wherein said transitional phenomenon comprises reflectance.
11. The nanoparticle-nanostructured material composite of claim 8 wherein said transitional phenomenon comprises fluorescence.
12. The nanoparticle-nanostructured material composite of claim 8 wherein said transitional phenomenon comprises ionization.
13. The nanoparticle-nanostructured material composite of claim 8 wherein said transitional phenomenon comprises field emission.
14. The nanoparticle-nanostructured material composite of claim 8 wherein said transitional phenomenon comprises charge separation.
15. The nanoparticle-nanostructured material composite of claim 8 wherein said transitional phenomenon comprises charge transfer.
16. The nanoparticle-nanostructured material composite of claim 8 wherein said transitional phenomenon comprises stimulated emission.
17. The nanoparticle-nanostructured material composite of claim 2 wherein said enhanced local fields are capable of increasing photovoltaic conversion.

18. The nanoparticle-nanostructured material composite of claim 1 wherein said nanoparticles comprise substantially spherical nanoparticles.
19. The nanoparticle-nanostructured material composite of claim 1 wherein said nanoparticles comprise substantially ellipsoidal nanoparticles.
20. The nanoparticle-nanostructured material composite of claim 1 wherein said nanoparticles comprise a size range limited by the feature size of the nanostructured material.
21. The nanoparticle-nanostructured material composite of claim 1 wherein said nanostructured material comprises a thin film.
22. The nanoparticle-nanostructured material composite of claim 1 wherein said nanoparticles comprise silver or silver alloys or silver compounds nanoparticles.
23. The nanoparticle-nanostructured material composite of claim 1 wherein said nanoparticles comprise gold or gold alloy or gold compound nanoparticles.
24. The nanoparticle-nanostructured material composite of claim 1 wherein said nanoparticles comprise iron or iron alloy or iron compound nanoparticles.
25. The nanoparticle-nanostructured material composite of claim 1 wherein said nanoparticles comprise palladium or palladium alloy or palladium compound nanoparticles.
26. The nanoparticle-nanostructured material composite of claim 1 wherein said nanoparticles comprise platinum or platinum alloy or platinum compound nanoparticles.

27. The nanoparticle-nanostructured material composite of claim 1 wherein said nanoparticles comprise copper or copper alloy or copper compound nanoparticles.
28. The nanoparticle-nanostructured material composite of claim 1 wherein said nanoparticles are mono-dispersed.
29. The nanoparticle-nanostructured material composite of claim 1 wherein said nanoparticles comprise a three-dimensional array.
30. The nanoparticle-nanostructured material composite of claim 1 wherein said nanostructured material comprises a void-column structure having a plurality of rod-like units.
31. The nanoparticle-nanostructured material composite of claim 30 wherein said nanostructured material comprises pores disposed between protuding units; said pores governing the size range of the nanoparticles.
32. A process for fabricating a nanoparticle-nanostructured material composite comprising the steps of:
 preparing a nanostructured material; and
 contacting the nanostructured material with a solution; nanoparticles being synthesized on said nanostructured material as a result of the contact.
33. A process for fabricating nanoparticles comprising the steps of:
 preparing a nanostructured material; and,
 contacting the nanostructured material with a particle precursor solution.
34. The process of claim 32 or 33 wherein said solution comprises a salt solution.
35. The process of claim 32 or 33 wherein said nanostructured material comprises a thin film.

36. The process of claim 32 or 33 wherein said nanostructured material comprises a void-column thin film having a plurality of rod-like units.

37. The process of claim 32 or 33 wherein said nanostructured material with a solution comprises facilitates dispersing the nanoparticles in order to minimize aggregation.

38. The process of claim 32 or 33 further comprising the step of:

electrically biasing the nanostructured material.

39. The process of claim 34 wherein the salt solution comprises a metal sulfate salt solution.

40. The process of claim 39 wherein the salt solution comprises a silver sulfate metal salt solution.

41. The process of claim 39 wherein the salt solution comprises a palladium sulfate salt solution.

42. The process of claim 34 wherein the salt solution comprises a metal nitrate salt solution.

43. The process of claim 42 wherein the salt solution comprises a silver nitrate salt solution.

44. The process of claim 42 wherein the salt solution comprises a paladium nitrate salt solution.

45. The process of claim 34 wherein the salt solution comprises a metal chloride salt solution.

46. The process of claim 45 wherein the salt solution comprises a copper chloride salt solution.

47. The process of claim 45 wherein the salt solution comprises a gold chloride salt solution.
48. The process of claim 45 wherein the salt solution comprises a tetraamminepalladium (II) chloride salt solution.
49. The process of claim 34 wherein the salt solution comprises a hydrogen tetrachloroaurate (III) salt solution.
50. The process of claim 32 or 33 wherein the solution contains an analyte.
51. The process of claim 50 wherein the analyte is utilized in a molecular detection application.
52. The process of claim 32 or 33 wherein the nanoparticles comprise silver nanoparticles.
53. The process of claim 32 or 33 wherein the nanoparticles comprise gold nanoparticles.
54. The process of claim 38 wherein the nanoparticles comprise iron nanoparticles.
55. The process of claim 32 or 33 wherein the nanoparticles comprise palladium nanoparticles.
56. The process of claim 32 or 33 wherein the nanoparticles comprise platinum nanoparticles.
57. The process of claim 32 or 33 wherein said nanoparticles comprise copper nanoparticles.
58. The process of claim 32 or 33 wherein the step of preparing a nanostructured material comprises preparing the nanostructured material by physical vapor deposition.

59. The process of claim 32 or 33 wherein the step of preparing a nanostructured material comprises preparing the nanostructured material by chemical vapor deposition.
60. The process of claim 32 or 33 wherein the step of preparing a nanostructured material comprises preparing the nanostructured material by electrochemical etching.
61. The process of claim 32 or 33 wherein the step of preparing a nanostructured material comprises preparing the nanostructured material by strain etching.
62. The process of claim 32 or 33 wherein the step of preparing a nanostructured material comprises preparing the nanostructured material by high density plasma deposition.
63. The process of claim 32 or 33 further comprising the step of:
 entraining the nanoparticles on the nanostructured material in a fluid stream.
64. The process of claim 32 wherein the solution is a precursor solution.
65. The process of claim 32 or 33 further comprising the step of:
 exporting the nanoparticles from the nanostructured material.
66. The process of claim 65 further comprising the step of:
 transferring the nanoparticles to another material.
67. The process of claim 65 further comprising the step of:
 injecting the nanoparticles into a different structure.
68. A charge separation device fabricated by the process of claim 32.

69. A photovoltaic device fabricated by the process of claim 32.
70. A Raman scattering sensor for molecular detection fabricated by the process of claim 32.
71. A surface plasmon sensor for molecular detection fabricated by the process of claim 32.
72. The surface plasmon sensor of claim 71 wherein the surface plasmon sensor is a surface plasmon optical reflectance sensor.
73. The surface plasmon sensor of claim 71 wherein the surface plasmon sensor is a surface plasmon optical absorption sensor.
74. An optical absorption sensor for molecular detection fabricated by the process of claim 32.
75. A fluorescent device fabricated by the process of claim 32.
76. A fluorescence detection system fabricated by the process of claim 32.
77. A fluorescence enhancement system fabricated by the process of claim 32.
78. An ionization sensor fabricated by the process of claim 32.
79. A stimulated emission device fabricated by the process of claim 32.
80. A catalyst fabricated by the process of claim 32.

81. A device for coupling electromagnetic radiation from one system to another system fabricated by the process of claim 32.
82. An anti-reflection coating fabricated by the process of claim 32.
83. The process of claim 32 or 38 further comprising the step of:
selectively patterning locations of the nanoparticles on the nanostructured material.
84. An optical information storage device fabricated by the process of claim 84.
85. A magnetic information storage device fabricated by the process of claim 84.
86. An optical information storage device fabricated by the process of claim 32.
87. A nanoparticle-nanostructured material composite fabricated by the process of claim 32.
88. A nanoparticle synthesized by the process of claim 33.
89. A nanoparticle synthesized by the process of claim 63.
90. A nanoparticle synthesized by the process of claim 65.
91. A nanoparticle synthesized by the process of claim 66.
92. A nanoparticle synthesized by the process of claim 67.
93. A nanoparticle synthesis reactor comprising:
a nanostructured material; and
a fluidics system capable of directing a fluid stream,

carrying a precursor solution, over said nanostructured material.

94. The process of claim 34 wherein the salt solution comprises a pure metal salt solution.

95. A catalytic sensor fabricated by the process of claim 32.